CLAIMS

1. A flotation device including:

an upstream tank to contain slurry incorporating fine and coarse particles containing minerals to be extracted;

a feed inlet for admission of slurry into the upstream tank;

agitation means to agitate the slurry within the upstream tank;

aeration means to aerate the slurry within the upstream tank, whereby floatable minerals in suspension float upwardly to form a surface froth for removal via an overflow launder;

a bottom outlet for withdrawal of relatively coarse or dense components of the slurry from the upstream tank, the bottom outlet directing the relatively coarse or dense components of the slurry into a downstream tank configured for optimal treatment of a slurry including a relatively high proportion of relatively coarse or dense components; and

a side outlet for withdrawal of relatively fine or lower density components of the slurry from the tank.

2. A flotation device according to claim 1, wherein the side outlet is adapted to remove slurry containing a relatively high proportion of gangue slimes from the top half of the tank.

3. A flotation device according to claim 1 or claim 2, wherein the side outlet is adapted to remove slurry containing a relatively high proportion of gangue slimes from between a mixing zone of the rotor and a froth zone near the tank surface.

4. A flotation device according to any one of claims 1 to 3, wherein the side outlet is adapted to remove slurry from the top third of the tank.

5. A flotation device according to any one of the preceding claims, wherein the side outlet includes a fluid conduit extending inwardly from the tank sidewall.

6. A flotation device according to claim 5, wherein the conduit terminates near the centre of the tank, generally proximal a vertical axis of the tank.

7. A flotation device according to any one of the preceding claims, wherein the side outlet directs the lower density components to a separate slurry processing unit configured for optimal treatment of relatively fine particles.

8. A flotation device according to any one of the preceding claims, wherein the flotation device includes a top substantially hollow deflection cone fixed with respect to the tank and extending generally around the drive shaft.

9. A flotation device according to claim 8, including a fluid conduit extending through a sidewall of the top cone to the side outlet to facilitate fluid transfer from within the top cone to the side outlet.

10. A flotation device according to claim 8 or claim 9, including a bottom substantially hollow deflection cone, also extending generally around the drive shaft, at a position below the top cone.

11. A flotation device according to claim 10, wherein the bottom cone is axially movable relative to the drive shaft to allow the area of an annular opening between the cones to be adjusted.

12. A flotation device according to claim 10 or claim 11, wherein the lower end of the top cone is nested at least partially within the upper end of the bottom cone.

13. A flotation device according to any one of claims 8 to 12, wherein the top cone is truncated and includes an opening at its lowermost end.

14. A flotation device according to any one of claims 8 to 13, wherein the lowermost end of the bottom cone fits relatively closely around the drive shaft, substantially to prohibit slurry flow through a region between the lowermost end of the bottom cone and the drive shaft.

15. A flotation device according to any one of the preceding claims, wherein the agitation means includes a rotor supported for rotation within a surrounding stator, and operable by means of a central drive shaft extending downwardly into the tank.

16. A flotation device according to any one of the preceding claims, wherein the aeration means includes an air blower and a fluid conduit for directing air from the blower into the agitator.

17. A flotation device according to claim 16, wherein the aeration means conduit includes an axial bore extending through the drive shaft of the rotor.

18. A flotation device according to any one of the preceding claims, wherein the tank is right circular cylindrical.

19. A flotation device according to any one of the preceding claims, wherein the bottom outlet is defined by an opening in the lower half of the tank.

20. A flotation device according to claim 19, wherein the opening defining the bottom outlet is in the tank sidewall adjacent the tank floor.

21. A flotation device according to claim 19, wherein the opening defining the bottom outlet is in the tank floor adjacent the tank sidewall.

22. A flotation device according to any one of claims 1 to 17, wherein a lower portion of the tank is conical in shape such that the relatively dense and coarse components of the slurry are directed toward the bottom outlet upon settling from solution or suspension.

23. A flotation device according to any one of the preceding claims, including a plurality of downstream tanks, each configured for optimal treatment of a slurry including a relatively high proportion of relatively coarse or dense components and each having an inlet connected to the bottom outlet of its adjacent upstream tank.

24. A flotation device according to claim 23, wherein all of the downstream tanks are substantially identical, with each tank including a side outlet for withdrawal of relatively lower density components of the slurry from an adjacent upstream tank.

25. A flotation device according to claim 23 or claim 24, wherein a side outlet of each tank directs lower density slurry components to a separate slurry processing unit configured for optimal treatment of relatively fine particles.

26. A flotation device according to claim 23 or claim 24, wherein only the third and subsequent tanks in a series of the tanks include a side outlet for withdrawal of relatively lower density components of the slurry from the tank.

27. A flotation device according to any one of claims 23 to 26, wherein the plurality of tanks is arranged in pairs, wherein the level of the base of each successive tank pair is lower than the base of its adjacent upstream pair, such that slurry flows under the influence of gravity from one tank pair to the next.

28. A flotation device according to any one of claims 23 to 26, wherein the plurality of tanks are arranged in groups of more than two, wherein the level of the base of each successive tank group is lower than the base of the adjacent upstream group, such that slurry flows under the influence of gravity from one tank group to the next.

29. A flotation device according to claim 27, wherein the outlet from one tank pair to the adjacent downstream tank pair includes a valve to allow discharge of the relatively coarse or dense components of the slurry.

30. A flotation device according to claim 29, wherein the valve is a dart valve.

31. A flotation device according to claim 30, wherein the valve is positioned substantially within the tank adjacent the outlet.

32. A flotation device according to claim 30, wherein the valve is positioned in a conduit extending between adjoining tanks.

33. A flotation device according to any one of the preceding claims, including an overflow launder for recovery and further concentration of mineralised surface froth.

34. A flotation device according to any one of the preceding claims, wherein the tank has a capacity of at least $100m^3$.

35. A flotation device according to any one of the preceding claims, wherein the slurry entering said upstream tank via the feed inlet includes less than around 55% solids.

36. A flotation device according to any one of the preceding claims, wherein the agitation means are aligned with the feed inlet, such that feed slurry entering the tank flows directly into the agitation means.

37. A method of separate size flotation in a flotation device, the method including the steps of:

providing a tank to contain slurry incorporating minerals to be extracted;

directing feed slurry into the tank;

agitating the slurry within the tank;

aerating the slurry whereby floatable minerals in suspension form a surface froth;

removing the froth via a launder system;

separately withdrawing relatively coarse or dense and relatively fine or lower density components of the slurry from the tank for separate downstream treatment.

38. A method according to claim 37, wherein after withdrawal from the tank, the relatively fine or lower density components are directed into one or more downstream fine particle flotation tanks specifically configured for optimal recovery of relatively fine particles.

39. A method according to claim 38, wherein after withdrawal from the tank and where the fine particles are predominantly gangue slimes, they are discarded.

40. A method according to any one of claims 37 to 39, wherein after withdrawal from the tank, the relatively coarse or dense components are directed into a separate series of one or more downstream coarse particle flotation tanks.

41. A method according to any one of claims 37 to 40, wherein the above process is repeated in the downstream tanks.

42. A method according to any one of claims 37 to 41, including the step of adding a flotation reagent to the slurry in the downstream tanks.

43. A method according to any one of claims 37 to 42, including the step of adequately diluting the slurry in the downstream tanks.

44. A method according to any one of claims 37 to 43, wherein said tank has a capacity of at least $100m^3$.

45. A method according to any one of claims 37 to 44, wherein said feed slurry includes less than around 55% solids.